Volume 47 AUGUST, 1961 Number 8

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

FIFTY YEARS

PUBLISHED BY
TEXACO INC.
TEXACO PETROLEUM PRODUCTS

HERE!

ADD UP TO 4% TO YOUR NET PROFIT

Caught in a profit squeeze? The contents of the Texaco man's briefcase can help you do something about it. Inside is Texaco's "Stop Loss" Program. It's a new cost control tool that can knock as much as 15% off your maintenance costs by showing you how to organize your lubrication. You can tack this saving directly onto profit—for an average 4% net gain. It will pay you to get the details. Write for our folder "How to Starve a Scrap Pile." TEXACO INC., 135 East 42nd Street, New York 17, N. Y. Dept. L-180.

TEXACO

LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

Published by

Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

Vol. XLVII August, 1961 No. 8

Change of Address: In reporting change of address please give both old and new addresses.

FIFTY YEARS

THIS Golden Anniversary issue, the 541st of the extraordinary series shown in Figure 1, marks the completion of a half century of gratuitous yet unbiased information and technical service to science, industry, education and the general public throughout the free world.

The magnitude and rarity of such an accomplishment should certainly excuse a little immodesty during an examination of the influences which have contributed to it. It is hoped that this account will not only interest most readers and answer many of the questions that they are continually posing, but will collect and preserve information of value to future readers, authors and editors.

The unique characteristics of today's publication are succinctly described as: technical, impersonal, authoritative, didactic, unbiased, modest and noncommercial. Not all of these were applicable to the earliest issues but were gradually attained during the first twenty years of effort. To differentiate and emphasize previous conditions from those of the present, *current practices or policies are printed in italics.*

PURPOSE AND DISTRIBUTION

This publication was originally and solely intended as a strictly internal means of disseminating technical information among the lubricating engineers in the sales department of the parent corporation.[8-11] Since this purpose was quite obvious, the charter subtitle of "A Technical Publication devoted to the Selection and Use of Lubricants" did not appear until much later.[2-20] It soon became apparent, however, that the number of copies being distributed was considerably greater than the number of company engineers. An editorial[10-13] acknowledged that readers outside the parent corporation were responsible for the expanding distribution and formally welcomed them. Since that date *all requests for placement on the distribution list are honored which originate outside the iron and bamboo curtains.* Representatives of competitive oil companies are freely included in the distribution and are among its most enthusiastic adherents: in fact, its reputation for authoritativeness and lack of bias frequently permits them to use it in furthering their own business. In all cases the sponsoring corporation asks only one small service from its "subscribers": that they advise address changes promptly, giving *both* the old address and new one. Unless the old address is given accurately (as by returning the mailing envelope) it is usually impossible to locate the old addressograph plate among 50,000 others, consequently wasteful duplication will occur.

8-11 Announcement Editorial, Magazine LUBRICATION, August 1911. Further references to previous issues will be similarly indicated by giving the month and year as superior figures but without a corresponding footnote.

	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Jan.				24		12	16	16			16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Feb.			16			12	16	16		12	16	28	16	16	16	16	16	16	16	16	16	16	16	16	16
Mar.		14				12	16	20		16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
April						12	16	20		16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
May			20			12	20	20		16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
June		14				12	16	20		16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
July				28		16	16	20		16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Aug.	16					16	16	20		16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Sept.						16	16	20		16/16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Oct.		16	24			20	16	16		16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Nov.				24	16	16	16			16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Dec.	16				12	20	16			16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16

	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
Jan.	16	16	16	16	16	16	16	16	12	16	12	16	16	16	16	16	16	20	20	16	16	16	16	16	16	16
Feb.	16	16	16	16	16	16	16	16	12	16	16	16	16	16	16	12	16	16	16	20	24	16	20	28	20	20
Mar.	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	20	16	20	20	16	20	20	20	20	16	16
April	16	16	16	16	16	16	16	16	16	12	16	12	16	16	16	16	20	20	16	12	16	12	20	16	28	16
May	16	16	16	16	16	16	16	16	20	16	16	16	16	16	16	16	16	20	16	16	20	20	20	16	20	16
June	16	16	16	16	16	16	16	12	12	12	16	16	16	16	16	16	20	16	20	16	16	16	16	12	16	12
July	16	16	16	16	16	16	16	12	12	16	20	16	16	16	16	16	20	16	12	16	16	20	16	20	16	16
Aug.	16	16	16	16	16	16	16	16	12	16	20	20	16	16	16	16	16	12	16	16	12	16	16	20	12	12
Sept.	16	16	16	16	16	16	20	16	16	16	16	16	16	16	20	20	20	16	16	16	20	12	24	20	12	
Oct.	16	16	16	16	16	16	16	16	16	16	16	12	16	16	16	20	16	12	16	16	12	16	24	16		
Nov.	16	16	16	16	16	16	16	20	16	16	12	16	16	16	16	16	16	16	20	16	20	12	24	16	12	
Dec.	16	16	16	16	16	16	12	16	12	16	12	16	16	16	12	12	20	16	16	16	16	16	24	28		

H. Tipper, Mar. 1911 thru July '16 (20 issues)
Dr. L. H. Canfield, Aug. '16 thru Oct. '18 (27 issues)
Dr. R. Haskell, Feb. '20 thru June '22 (30 issues)
A. F. Brewer, July '22 thru June '54 (380 issues)
Dr. R. K. Gould, July '54 thru July '57 (37 issues)
Col. J. T. Bugbee, Aug. '57 thru Aug. '61 (46 to date)

Figure 1 — Magazine LUBRICATION's fifty-year publication record. Figures indicate total number of pages (including the four covers). Underlining is used to mark the use of color in one or more illustrations. Brackets designate dual issues covering two calendar months.

Within seven years[11-18] of its inception the primary English edition of this publication was not only being distributed throughout the United States, but had established its first international edition in the Portuguese language. As international demand continued to increase, further expansion occurred. *The magazine is now published and distributed worldwide in the following six languages and seven editions: Primary English; Portuguese; Spanish; European English; French; German; Italian.* The first four are monthly publications and almost equivalent translations; the last three are quarterlies which may condense, translate and combine as many as three previous English language issues related to a given subject. Before linguistically inclined readers are tempted, let it be stated that *distribution*

of any edition outside of its country of origin is unusual and expensive and should not be requested.

The size of the initial run is not recorded but probably did not exceed 200 copies. Seven years later[11-18] the English and Portuguese issues totaled 25,000 copies. *Today's seven editions provide more than 100,000.*

As noted in the heading of the most recent index,[12-59] copies of past issues are readily available during the month after issue, decreasingly so up to two years and only rarely thereafter. Residual stocks of two year old issues are divided among requesting universities and colleges which use them as supplementary text books.

SIZE AND COLORS

As illustrated in Figure 2, the original publication was a somewhat smaller booklet. Thus it anticipated the currently-popular "pocket digest" size and maintained this size until the present dimensions were established.[2-20] Only the front cover used colors—black and a drab grey-green which has undoubtedly faded still more in fifty years. Color on a cover is mainly "eye appeal" designed to attract the reader, arouse his curiosity and urge him to look inside. But color properly used in an illustration can add immeasurably to understanding. As a consequence of their complexity and additional expense, colored illustrations have been used very sparingly in this publication and as shown in Figure 1 the first one was postponed almost seventeen years.[2-20] *Current policy continues to restrict color to those illustrations which are necessary and absolutely require it.*

The general style and illustrations of the front cover have also changed from a pair of electric generators driven by Corliss steam engines (faintly discernible in Figure 2) to pictures of a milling machine[2-20] and a mine hoist,[5-20] but no picture at all thereafter.

SUBJECTS AND STYLE

Figure 2 also discloses two other early peculiarities —an editorial, and as many as ten unrelated subjects in a single issue.[11-14] One editorial[2-16] made two true statements which are worthy of repetition: "It will be worth your while to save your copies of LUBRICATION, as a complete file may, at some future date, be of value in clearing up some points on the testing and properties of oils." "If you like 'new' LUBRICATION, tell us—it helps considerably. Likewise if you don't like it—and why." Editorials of this sort on a variety of subjects including World War I continued with fair regularity during the first seven years[10-18] but *policy forbade such obvious and pointed attempts to influence opinion thereafter.* Multiple subjects were continued irregularly for several years,[9-37] possibly because so little was known about any single subject that several could be crammed together. *Current policy permits only a single subject per issue and more than one issue on the same subject are occasionally required.* With this issue solely excepted, *a subject must permit some discussion of some facet of the science of lubrication.*

As might be anticipated from its original purpose and wholly internal distribution, the earliest issues of this publication were crowded with very obvious sales promotional statements in which the name of the sponsoring company and the excellence of its brand-named products were clarioned in almost every paragraph. Testimonial letters from satisfied customers were proudly reprinted. Newspaper and magazine articles were quoted at length and particularly if they named and praised a certain brand of lubricants. Writing style was highly informal and personal, with the vertical pronoun always prominent. Very little was entrusted to the imagination of the company salesman and modesty was unknown. Due to the accumulating pressures of World War I, this publication was temporarily discontinued with its October 1918 issue (only two or three weeks before the Armistice). When publication was resumed,[2-20] editorial responsibility was transferred to a wholly technical group with consequent change in tone and emphasis which closely approached those of today. *Current policy forbids any direct mention in the text of the sponsoring company's name, its installations or its branded products and permits only the impersonal third person neuter style of writing.*

EDITORS AND AUTHORS

Present-day readers often remark that the uniform quality of this publication reflects the activity of large editorial and writing staffs. They are amazed

Figure 2 — Front covers and sizes of the first (August 1911) and five hundred and forty-first (August 1961) issues of this publication.

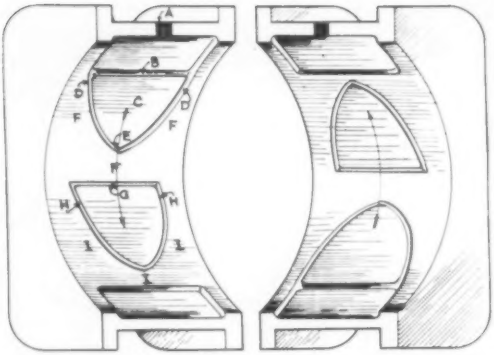


Figure 3 — The first illustration to be used in this publication. (Reproduced from Figure 1, March 1912 issue).

and often a little doubtful when informed that there is *no* full-time editorial staff and *no* corps of professional writers. On the contrary, the editor, his assistant and the authors all perform their publication functions in addition to their normal technical assignments, and quite frequently after normal office hours during their own "free" time.

During the fifty year history of this publication there have been innumerable authors but only the six editors shown in Figure 1. All but the first editor have been technical men, most often with advanced engineering degrees though none had received any special training in journalism. One served thirty-two years and supervised 380 issues, a record which is not likely to be duplicated. Since the editor (or more accurately the "editor-in-chief" because of the seven editions which he initiates) is responsible for supervising or accomplishing every detail on the primary English edition between choice of subject and distribution of the printed issue, these six men have been the most potent force in promoting continuity of policy and uniformity of quality. Probably no one but the editor himself has noticed another highly distinctive peculiarity of this publication: no editor's name has appeared in its masthead during more than forty-three years[2-18]. His principal satisfaction is a continual broadening of his basic technical training and experience.

Though authors for some of the earliest issues were recruited outside, every author in recent years has been an employee of the sponsoring corporation, and practically always from its research and technical organization. Each author—a different one every month—is selected on the twin bases of authoritativeness in the assigned subject and his availability for this extra duty. Whether or not he has also demonstrated proficiency as a technical writer is rarely considered. His most important duty is to gather and marshall the facts: the editor will assist him in presenting them. In brief, the combination in one person of both technical and writing expertness continues to be rare. Reason and considerable experience both indicate that it is much simpler to make a technical man into a writer than the reverse.

Like the editors', an author's name has not appeared in this publication in many years,[10-18] though he is usually awarded such a by-line if his article is subsequently and completely reprinted in some other periodical. Aside from the personal satisfaction of having accomplished a truly difficult task, an author's principal reward is the enforced opportunity of organizing and presenting his thoughts, thereby becoming even more expert in his chosen technical field.

MEMORABILIA

Though more than 100 of the principal libraries in the United States have assiduously collected and bound copies of this publication, the only complete fifty-year set (detailed in Figure 1), available to the general public, is preserved in the Fifth Avenue building of the New York Public Library. Since several other collections go back as far as 1920, the following extracts and illustrations from the preceding and largely unavailable issues will indicate forty years of progress while arousing some nostalgia among senior readers.

The second issue[12-11] reported one of the earliest customer's complaints—and (of course) its triumphant solution by means of very modern technical investigative methods. The customer blamed a certain brand of steam cylinder oil for deposit formation in a large steam engine cylinder. The deposit was carefully removed by that early technical service man, and rushed by railway express to the nearest company analytical laboratory. There a chemist determined that sixty percent of the deposit was composed of such water and oil insoluble materials as abrasive silica (sand) with oxides of iron, aluminum, calcium and magnesium. Since all these materials were foreign to the oil and all but the iron were also strange to the engine, the technical service man correctly deduced that they must have come from the boiler as a result of "priming" (foaming) and carry-over. Cleaning the boiler and using treated feed-water solved the "oil" problem. A more recent issue[3-58] describes the investigation and solution of twenty-three more complex technical service problems.

Figure 3 reproduces the first illustration[3-12] used in this publication and illustrates the complex bearing oil distribution grooves that were believed to be necessary in those days. Modern bearings are usually devoid of the simplest grooves since it is now realized that they are not only unnecessary in pressure-fed bearings but actually decrease load carrying ability.

When this publication was founded, the principal lubrication requirements were in the industrial and marine fields. In fact, the first issue[8-11] reprinted

Figure 4 — USS Texas at full speed. (Reproduced from July 1914 issue.)

an article by Lieutenant Commander H. P. Price, U.S. Navy, titled "Some Remarks on the Delaware as a Cruiser Battleship" and reported "The run of 4,918 miles (from Hampton Roads) to Rio de Janeiro was made at an average speed of 12.92 knots using 1,922 tons Pocahontas coal." With its fourteen boilers (and hard working hand stokers of the black gang) at full capacity the Delaware's reciprocating engines developed 19,000 IHP (indicated horse-power) and averaged 20.07 knots. An unusual feature (for that period) of the Delaware was that it could burn either or both coal or fuel oil; oil was apparently regarded as the emergency high-performance fuel while coal was the normal fuel because of its world-wide availability. Less than three years later[1-14] "Uncle Sam's Greatest Fighting Machine," the 573 foot battleship Texas pictured in Figure 4, was described as developing 28,100 IHP and 22.2 knots. After service in two World Wars, the Texas is now permanently moored as a monument in the San Jacinto battlefield near Houston, Texas. The battleship era was probably closed with the recent moth-balling of World War II battleship Missouri which pushed its 57,150 tons along at better than 35 knots.

The first mention of the automobile occurred in an article[6-12] by William H. Stewart, Jr. which was reprinted from the New York Herald newspaper. After discussing adjustment of the oil sight-feed indicators (which were very prominent dash instruments in those days) Mr. Stewart closed with the sage words: "Regarding the grade of oil to use in a motor, it is enough to say that the best grade obtainable is cheap in the long run. A great many owners attempt to economize in oil. But the few cents saved is later expended for labor in cleaning out excessive carbon and constant grinding of the valves. The man who purchases an automobile should be prepared to give it proper lubrication, as cheap oil and grease will do more to depreciate the value of an automobile than actual service." In those days the motor oil was blamed for carbon formation which seemed in turn to contribute to "spark knock": today's "combustion chamber deposits" are mainly caused by incomplete combustion of the gasoline, but they still contribute to knocking and other types of uncontrolled combustion. Those early engines also devoured (and leaked) so much oil that every motorist carried several extra quarts on relatively short trips. Since the oil's residence in the crankcase was so brief, oxidation and contamination were negligible. The necessity for regular crankcase drains would not arise until future higher-powered engines with minimum oil consumption and tiny crankcases came into being.

Another article[10-12] reported that every piece of equipment being used in the construction of the Big Ditch (Panama Canal) was being lubricated under exclusive contract with a well known petroleum company.

A worried university professor reported[2-13] that the 1,000,000 cars then in the United States averaged 25 horsepower and consumed 4,500,000 gallons of gasoline per hour at a cost of $700,000. The reader should note that this cost of only 15.5 cents per gallon occurred long before the application of state and federal taxes which now total as much as 11 cents per gallon.

Since the total annual gasoline capacity of U. S. refineries at that time however was only 1½ billion gallons he recommended that the 3 billion gallons of kerosene then "available" be taken from the kerosene lamps and added to the gasoline. Adoption of his suggestion would have plunged most of the country into darkness, worn out a lot of automobile engines because of excessive dilution of crankcase oil, and probably prevented the rest of them from even starting on a cool morning. Communications must have been exceedingly poor in those days: the thermal cracking process, which could synthesize almost limitless quantities of gasoline from crude oil, had been invented two years before the professor's article and only 120 miles distant from him!

As shown in Figure 5, aviation also made its debut at an early date[7-14] in this publication. The America

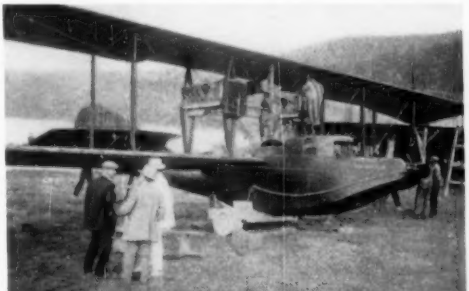


Figure 5 — Airboat America with its two 100 HP Curtiss engines. Mr. Curtiss, the builder stands on the left of the group of three with Lieutenant Porte, the pilot on the right. (Reproduced from July 1914 issue.)

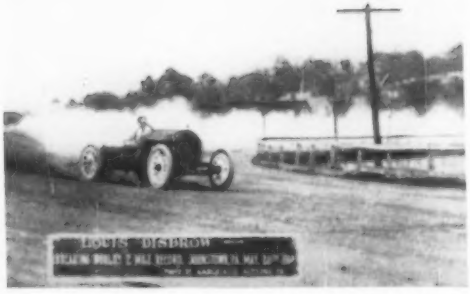


Figure 6 — Louis Disbrow in his Simplex Zip breaking the world's two-mile record. (Reproduced from November 1914 issue.)

was built with the intent of flying the Atlantic from Newfoundland to the Azores and thence to Spain. The two one-hundred horsepower engines were pretested by successfully running thirty hours at speeds between 1,000 and 1,250 rpm. The four reciprocating engines of today's airliner develop about 13,000 horsepower and the jets are even higher.

Figure 6 shows[11-14] Louis Disbrow, a famous early automobile racer, skidding around a flat turn on a dirt track of the customary county fairgrounds type. The speed record broken on that occasion is not stated, however, two months later he broke his own record by traversing a half mile track four times in 2 minutes, 13 3/5 seconds for an average speed of 53.9 mph. The tiniest of today's passenger cars could break that record and the larger ones would easily double it. On May 30, 1961 at Indianapolis, A. J. Foyt traveled 500 miles in Floyd Travis' car at an average speed of 139.13 mph.

Figure 7 from the same issue[11-14] shows Robert Edgren (Sporting Editor of the New York World) driving Mrs. Paula Blackton's "Baby Speed Demon" to victory in the Gold Challenge Cup at Lake George and establishing a world's record of 50.59 knots over a nautical mile (or 58.3 landlubber miles per hour). In those days travel on water was faster than on land and air travel was just beginning.

Dr. Rudolph Diesel built his first experimental compression-ignition engine (a single cylinder 20 HP air-cooled) at Augsburg, Germany in 1893. When the Diesel was first mentioned in this publication[11-15] the basic patents had expired two years previously and some fifteen American manufacturers had quickly prepared to furnish engines up to 5,000 HP. As might be expected, the technical details of the new diesels were most intriguing and a rash of articles appeared in this publication during the next two years which included the Busch-Sulzer,[1-16] McIntosh & Seymour,[2-16] Snow,[3-16] Southwark-Harris,[4-16] two M.A.N. built by the U.S. Navy for the fuel oil ship USS Maumee,[11-15, 6-16, 12-16, 1-18] Muncie semi-diesel,[9-16] the Burnoil or Bruns,[2-17] general lubrication of several types,[7-17] and the Fulton[10-17].

Because of exceptionally close connection with their construction and testing, considerable information on the Maumee's engines shown in Figure 8 has been preserved. These two engines, the first government built diesels, were constructed by the U.S. Navy from blueprints originally furnished by MAN (Maschinenfabrik Augsburg-Nuernberg) through the Electric Boat Company which performed the formidable task of converting all dimensions from the original but unfamiliar metric to the English system of units. The author of an article reprinted from another publication plaintively remarked: "It would perhaps have been cheaper to build the engines from the original metric dimensions, as the translated drawings contained decimals to the thousandths of an inch and made the shop work rather slow and tedious." Was this an indirect compliment to German precision, or a mistaken notion that one system of units was more restrictive than the other? In any case the Maumee's two MAN's were completed under the supervision of Navy Lieutenant C. W. Nimitz (Fleet Admiral Chester W. Nimitz in World War II) and, like their supervisor, served faithfully and most efficiently for many years thereafter.

One enthusiastic but remarkably biased and undiplomatic article on diesels[11-15] practically recommended that all steam engines be scrapped forthwith. In an attempt to clinch his arguments, the author pointed out that President Woodrow Wilson had personally started a 500 HP Busch-Sulzer in 1915 at the San Francisco World's Fair (actually the Panama-Pacific International Exposition celebrating completion of the Panama Canal). In any case, the editor of this publication was not easily stampeded since a pair of horizontal reciprocating steam engines continued to decorate the front cover for several years thereafter.[10-18] *Current and long-standing policy requires that whenever a controversial subject must be discussed, this publication will normally present the facts, both pro and con, without bias and allow the reader to draw his own conclusions. Where an opinion is expressed its origin is plainly labeled.*

The next issue[12-15] discussed the lubrication of two very large producer-gas engines and stated "con-

Figure 7 — "Baby Speed Demon" driven by Robert Edgren.

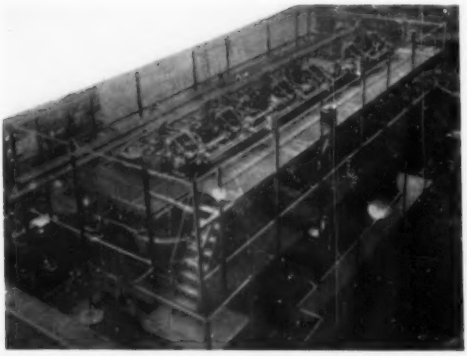


Figure 8 — One of the USS Maumee's pair of six cylinder two-cycle diesel engines, largest in the world at that time. Nominal rating of each engine was 2600 shaft horsepower but attained 3170 SHP on proof test. Engine bed plates were 43 feet long, 14 feet wide. Engine heighth above bed plate was 25 feet. (Reproduced from January 1918 issue.)

siderable trouble was also experienced with premature explosions due to formations of carbon." This is one of the earliest references to "preignition," "deposit ignition" or "surface combustion" which is still a problem and a major factor which limits the compression ratio of today's gasoline engines. As might be expected the early problem (at least) was solved by using a better crankcase oil.

In an article[1-17] titled "Lubrication of Truck and Tractor Engines" Mr. Harry L. Horning of Waukesha Motor Company foreshadowed the necessity for draining engine crankcases regularly though his conclusions were based solely on the adverse effects of fuel dilution. The Horning Memorial Award, presented by the Society of Automotive Engineers, encourages the continuing effort to make better partners out of fuel and engine.

Figure 9 illustrated an account of one of the earliest road tests in which a 1917 four-cylinder Maxwell car (costing $580) traveled a transcontinental circuit of 9,615 miles over the abominable rutted sand, clay, flooded and even wooden-plank roads of that day. The report stated: "On a level road it would run 34 miles per hour in second speed and in high speed 49 miles per hour on a plank road." Average speed over the first 3,450 miles was 23.6 miles per hour and the average gasoline economy over 7,197 miles was 20.2 miles per gallon.

Five months later[8-17] Mayor Curley of Boston started a Model 27 Oldsmobile 6 on what was pos-

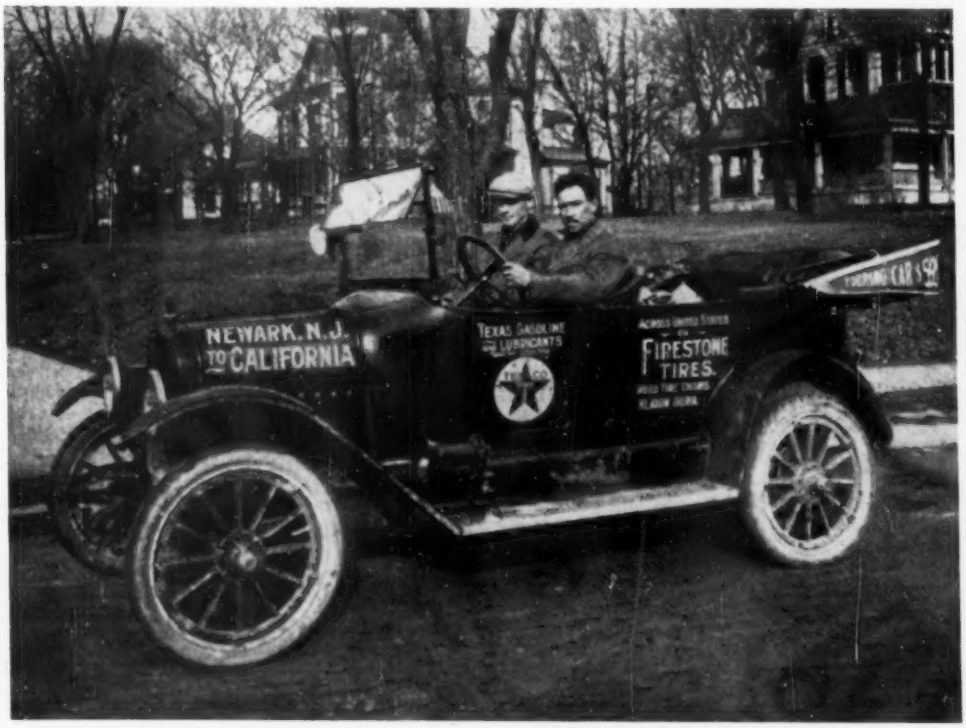


Figure 9 — 1917 Maxwell transcontinental road test car. (Reproduced from March 1917 issue.)

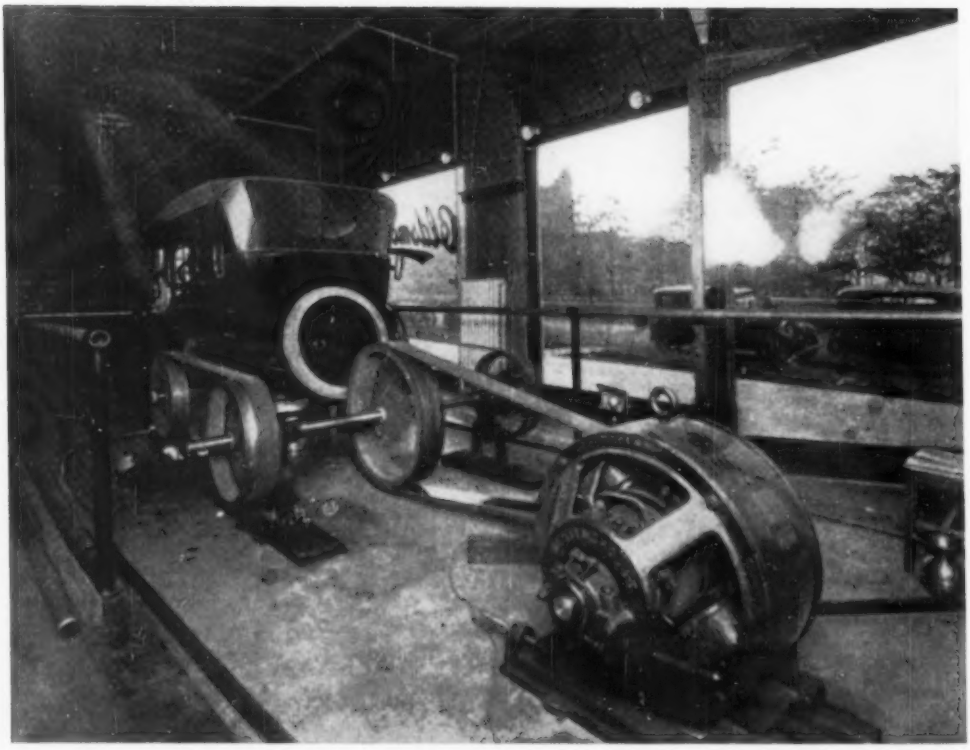


Figure 10 — Model 27 Oldsmobile 6 on an early chassis dynamometer. (Reproduced from August 1917 issue.)

sibly the first chassis dynamometer, pictured in Figure 10. The construction and use of this novel instrument may have been encouraged by the cross-continental roads and uncertain supplies which the Maxwell had braved. In any case, after more than seventeen days (precisely 1,128 hours) of uninterrupted operation, the Oldsmobile had covered the equivalent of 26,149.3 miles at an average speed of 23.2 mph with average economies of 22.5 mpg of gasoline and 950 mpg of motor oil.

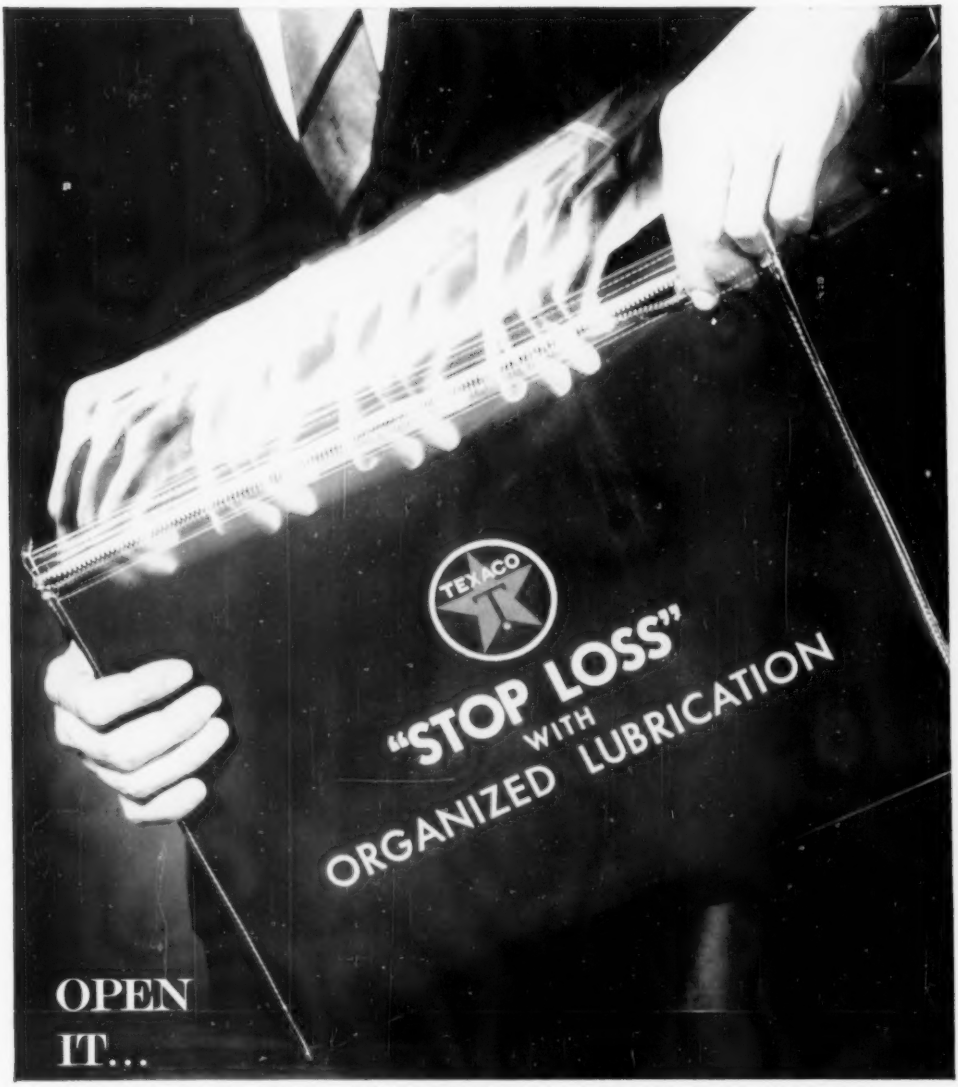
Though the United States entered World War I in April of 1917, the requisite advance preparation of this publication postponed any reaction until the September 1917 issue which devoted its first two pages to reproductions of United States Food Administrator Herbert Hoover's food conservation pledge and home cards. Subsequent issues urged: conservation of fuels and lubricants;[9-17, 5-18, 9-18] sperm whale meat for human consumption;[12-17] investment in Liberty Bonds;[1-18, 2-18, 4-18, 6-18, 8-18, 9-18] purchase of War Savings Stamps;[3-18, 5-18, 6-18] contributions to the Red Cross War Fund Drive;[5-18] combat of enemy propaganda;[7-18] volunteer of submarine engineer officers;[6-18] salvage of tools;[6-18] the YMCA;[10-18] conservation of castor oil.[8-18]

The last campaign on vegetable castor oil by a petroleum company deserves some explanation. Prior to World War I, the principal use of castor oil was to lubricate worm and other reduction gearing on building elevators. During the war however large quantities were required for the crankcase lubricant of the Gnome and Le Rhone aviation engines in the pursuit planes which our allies supplied to us. World War I ended (November 1918) before the fine petroleum-lubricated American Liberty aviation engines could reach the Western Front, nevertheless the use of castor oil as an engine lubricant declined rapidly thereafter. For elevator and most other lubrication uses it was replaced with heavy straight mineral oil which was much more satisfactory, more available and less expensive.

SUMMARY

This Golden Anniversary issue, the 541st of an extraordinary series, marks the completion of a half century of gratuitous yet unbiased information and technical service to science, industry, education and the general public throughout the free world. It is hoped that reader response will continue to encourage publication.

Printed in U.S.A. by
The Georgian Press Inc.
175 Varick Street
New York 14, N. Y.



FOR UP TO 4% EXTRA NET PROFIT

In the Texaco man's briefcase is a plan for cost control through organized lubrication—Texaco's "Stop Loss" Program. Management in many different industries is already using it to cut operating costs. The resulting savings go directly into profits. Up 4% is the average. To find out how you can turn excessive costs into profit, write for our informative folder: "How to Starve a Scrap Pile." **TEXACO** INC., 135 East 42nd Street, New York 17, N.Y. Dept. L-190.

TEXACO